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# QUARTERLY STATUS AND TECHNICAL PROGRESS REPORT

Title: Evaluation of Spatial, Radiometric and Spectral Thematic Mapper Performance for Coastal Studies

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1. Problems

Only one TM image of our Delaware Bay test site was available (P014, R033, 12/13/82) and due to snow cover, it was unsuitable for marsh vegetation (biomass) studies. To solve the problem, one of our Chesapeake Bay test sites was activated and an available high-quality TM image ordered (P015, R033, 11/02/82). Due to the delay in transmitting additional TM data from Landsat-4, four more scenes of similar test sites were ordered (P014, R032, 11/27/82; and P012, R031, 9/10/82). Pictures and tapes for all scenes have been received and analysis of the Chesapeake Bay scene has been initiated. We are eagerly awaiting TM data from Landsat-5. Since our test sites are more distant than the original ones proposed, and since there are more of them, we are in the process of requesting a small increase in the travel and data analysis budgets.

2. Accomplishments

The majority of our most recent efforts have been to modify our computer software (a version of the Pennsylvania State ORSER package) to read and analyze CCT-AT and CCT-PT formatted data. This task has been completed and we now have an operational version of the software.

Analysis of ground-gathered Thematic Mapper data is continuing. The main emphasis of the research was to determine what effect different wetland plant canopies would have upon observed reflectance in Thematic Mapper bands. The three major vegetation canopy types (broadleaf, gramineous and leafless) produce unique spectral responses for a similar quantity of live biomass. Biomass estimates computed from spectral data were most similar to biomass estimates determined from harvest data when models developed for a specific canopy were used. In other words, the spectral biomass estimate of a broadleaf canopy was most similar to the harvest biomass estimate when a broadleaf canopy radiance model was used. Work is continuing to more precisely determine regression coefficients for each canopy type and to model the change in the coefficients with various combinations of canopy types. We suspect that textural and spatial considerations can be used to identify canopy types and improve biomass estimates from Thematic Mapper data. We expect to test these models when a summer TM image of the Canary Creek/Great Marsh area becomes available.

As noted in previous progress reports, we have also classified two subscenes of TM imagery believed to include significant amounts of Submerged Aquatic Vegetation (SAV). The first image classified was of Broad Creek, Maryland, just north of the Choptank River. The second image classified was of Vaucluse Shores/Hungars Creek, located in the southern portion of Chesapeake, north of the Bay Bridge Tunnel. In both cases, the classification resulted in moderate success. However, in the Vaucluse Shores image, the classifier frequently misclassified SAV as deep water and vice versa. We are presently attacking this problem by including spatial clues within the classification depth.

We continue to refine our radiative transfer models describing volume reflectance of eight water columns containing SAV. Although the modeling efforts are progressing nicely, we hesitate to report any results until we can get out into the field and verify the model. We anticipate concluding that phase of the research by the end of this coming summer.

## 3. Significant Results

A preliminary comparison of Landsat MSS and TM for coastal application was presented at the Landsat D' Launch User Symposium (see Publications section). The results of this comparison are shown in Table 1.

Based on the three morphologic wetland canopy types, simple regression models were developed equating the vegetation index and the infrared index with biomass. Spectral data were collected with the hand-held radiometer from the ground and from a low altitude aircraft. Sampling points were arranged on a 30 m grid with actual harvesting of vegetation conducted after the radiance data were collected. With the vast majority of spectral radiance index and model combinations, the spectral radiance index estimates of total live biomass were not significantly different from the harvest biomass estimates. The species combination models for the vegetation and infrared indices were particularly good, with the all-species models being the best models for use with all three spectral radiance indices. The MSS vegetation index estimates were very similar to the vegetation index estimates. This is not surprising considering both indices contain essentially the same spectral information.

We have also found that all major wetland vegetation species can be clearly discerned in TM imagery. The spatial resolution of TM data appears to be better than 30 meters, i.e., it seems to be closer to 25 meters than 30 meters.

## 4. Publications


Ackleson, S. G. and V. Klemas. "Assessing Landsat TM and MSS Data for Detecting Submerged Plant Communities", Landsat-4 Early Results Symposium, NASA Goddard Space Flight Center, 23-24 February 1983.

Hardisky, M. A. and V. Klemas. "Remote Sensing of Coastal Wetlands Biomass Using Thematic Mapper Wavebands", Landsat-4 Early Results Symposium, NASA Goddard Space Flight Center, 24-23 February 1984.

Klemas, V. "Comparison of Landsat MSS and TM for Coastal Zone Applications", Landsat D' Launch User Symposium, Santa Barbara, CA, 27 February - 1 March 1984.

Ackleson, S. G. and V. Klemas. "Remote Reconnaissance of Submerged Aquatic Vegetation: A Radiative Transfer Approach", Third Landsat-4 Workshop, NASA Goddard Space Flight Center, Greenbelt, MD, 6-7 December 1983.

Hardisky, M. A. and V. Klemas. "Aboveground Biomass Estimation In a Tidal Brackish Marsh Using Simulated Thematic Mapper Spectral Data", NASA Goddard Space Flight Center, Greenbelt, MD, 6-7 December 1983.

## 5. Recommendations

All of our quantitative analyses are performed on digital tapes. Paper prints and transparencies are of great importance for selecting tapes and planning the digital tape analysis. Therefore, it is more important for us to obtain the paper prints and transparencies as early as possible (timely release) than to worry about small density deviations or scale errors in the film products. The paper prints and transparencies are usually sufficient for planning the processing of the digital tapes (e.g., test site location identification, cloud-free area selection, etc.).

## 6. Funds Expended

## 7. Data Utility

A joint project is being developed with the Maryland Department of Natural Resources Tidewater Administration to use Landsat TM for monitoring environmental changes in estuarine sanctuaries in Chesapeake Bay.

The Delaware State Highway Department is interested in using Landsat data for planning new highway corridors. This is an outgrowth of our work using Landsat data for developing and testing archeological predictive models, which are able to predict the potential location of historic Indian sites with a factor 2 better than any other available technique.

A project is being developed with Delaware State agencies to use Landsat-4 TM to study the environmental degradation of Delaware's inland bays (Rehoboth Bay, Indian River Bay, etc.). These bays are shallow, their shorelines are overdeveloped (e.g., summer homes, marinas, etc.) and, as a result, the pollution concentrations are reaching dangerous levels. The State is proposing to analyze TM data on our ERDAS system to study turbidity plumes and circulation patterns in the bays, and map changes in vegetation around the bays.

TABLE 1.

COMPARISON OF LANDSAT MSS

AND TM FOR COASTAL STUDIES

| APPLICATION | IMPROVEMENT |
|---|---|
| Vegetation and Land Use Mapping | Medium |
| Biomass Measurement | Major |
| Submerged Aquatic Vegetation | Major |
| Eutrophication Phytoplankton Blooms | Medium |
| Suspended Sediment Currents, Turbidity Fronts | Medium |
| Pollution Plumes Ocean Dumping | Medium |
| Bathymetry Erosion Control | Major |
| Ship Traffic Harbor Planning | Major |
| Gross Coastal Geomorphology | Minor |
| Sargassum Open Ocean Fronts | Medium |
| Internal Waves Sea State | Minor |